DEVELOPMENT AND PROTOTYPING OF A TAKRAW BALL FEEDER FOR ACCURACY TRAINING BASED SYSTEM

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SUPERVISOR'S DECLARATION

We hereby declare that we have checked this project and in our opinion this project is satisfactory in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering.

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STUDENT'S DECLARATION

I declare that this thesis entitled *"Development and Prototyping of a Takraw Ball Feeder for Accuracy Training Based System"* is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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DEDICATION

To my beloved father,

Mohd Nazaruddin Bin Mohd Noor

My beloved mother,

Zainaf Binti Osman

and

All my beloved family members

Thank you for everything

ACKNOWLEDGEMENT

Bismillahirrahmanirrahim

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ABSTRACT

The development of electronic and automation in sport is well demanded to improve the training method. Ball feeder is one type of sport training equipment that is used for accuracy training purpose. Unfortunately, there is no automation equipment that had been developed for Sepak Takraw. Therefore, this work is published for the development and prototyping of takraw ball feeder for Sepak Takraw training purposes. This ball feeder used a gravity punching concept where it consists of a rotating arm that is moved by a driver connected to a power window motor to a certain position before the arm is release. The takraw ball feeder is capable to control the launching period of the ball where it is controlled by a controlling unit. This ball feeder invention will make Sepak Takraw training more effective than the current training method.

ABSTRAK

Pembangunan elektronik dan automasi dalam penghasilan alatan sukan sangat diperlukan bagi meningkatkan mutu latihan. Pengagih bola merupakan salah satu daripada alatan sukan yang digunakan bagi tujuan tersebut. Malang sekali, pada masa ini tiada pembangunan dan penghasilan pengagih bola bagi sukan Sepak Takraw. Justeru, tesis ini dihasilkan bagi pembangunan alat pengagih bola bagi sukan Sepak Takraw untuk diapplikasikan dalam latihan ketepatan. Alat pengagih bola ini menggunakan konsep hentakan berfaktorkan graviti di mana sebuah penukul akan digerakkan oleh pemandu yang disambungkan pada satu motor elektrik ke satu kedudukan tertentu sebelum punukul tersebut dilepaskan. Pengagih bola ini berupaya untuk mengawal sela masa untuk mengagihkan bola di mana sebuah unit pengawal akan menjalankan fungsi tersebut. Lantas, penghasilan pengagih bola ini akan dapat meningkatkan lagi mutu serta kualiti latihan sedia ada.

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LIST OF SYMBOLS AND ABBREVIATIONS

h	-	Height of launch
F	-	Force
H_o	-	Angular momentum
M	-	Moment
dv/dt	-	Aceleration
N	-	Newton
kg	-	Kilogram
g	-	Gravitational acceleration
t	-	Time
m	-	Mass
α	-	angel of rotation
v	-	Speed
d	-	Distance
PIC	-	Programmable integrated circuit
AC	-	Alternating current
DC	-	Direct current
CAD	-	Computer added design

CHAPTER 1

INTRODUCTION

1.1 Introduction

Sports are one of the activities that can give many benefits to human especially in generating health to our body. Apart from dieting, involving ourselves in sports can protect us from many diseases that can threaten our lives. History has proved that sporting activities has long been apart of human lifestyle, where the first Ancient Olympic games were held in Greece back on 776BC. Since then, sports have developed into many variety and disciplines. Until now, on the 21st century, sports have become a global culture where it is being used as a symbol to unite the people around the round. Nowadays, the presence of sports is undoubted as an important medium for the world's development as it can generate a strong relation among countries, organizations and human.

Through this relation, an array of sports event is being held to promote peace and strengthen the relationship among human. This scenario produced many international sports icon and globally renowned athletes from different kind of sports. Apart from hard work, the emerged of these athletes are being help by the involvement of technology in sports through the invention and creation of training equipment. Technology has long been part of sports development. The use of basic training equipment can give a big impact not only to the athlete, but the sports itself.

Because of this situation, the demand of electronic and automation in developing training equipments have increased. Sport organizations demand the use of electronic training equipment in the training. The increased in demand is caused by many factors such as to improve the training method. Before the invention of electronic training equipment, the training methods basically depend on the coach expertise. Therefore, a sport organization needs to hire a talented, expert and experience coach to work on the training. Unfortunately, there are few numbers of sports coaching expertise available and if there is some, the cost to hire them as a coach and the demand would be the main problem to the organization.

So, the used of automation training device would be a great solution to improve the training methods. The accuracy of automation training device is also on of the main factor that it is well demanded. Accuracy training is very important in most sporting activities and through the application of electronic, surely it will help a lot. These factors not only contributed to the cost efficiency, but make the training equipment very efficient and reliable during training.

Nowadays, there are many types of automation training equipments available in the market for almost kind of sports and one of the equipment is the ball feeder machine. The ball feeder machine is being use for sport activities such as tennis, golf, volleyball, softball and cricket. The basic concept in each of the ball feeder machine is to throw the ball through the ball outlet to the user automatically within the specific accuracy and speed. For general ball feeder machine, it contains several basic components such as motor, ball inlet and outlet, throwing unit and control unit.

For an example, the Kanon tennis ball machine that has been produce since 1975 use air pressure as throwing concept to support the training purpose. Until now, this machine has been widely use for tennis training purpose because of it revolutionize design.

1.2 History of Sepak Takraw

'Sepak Takraw' was the name of an ancient game played in the Malay states and in the neighboring countries of Singapore and Brunei. It was created by the royal family of Malaysia about 500 years ago. The name itself comes from two different languages. 'Sepak' is Malay for 'kick' and 'Takraw' is a Thailand word for the rattan ball used in the game, which involved players standing in a circle keeping the ball in the air for as long as possible without using their hands. Variations of this were played in other Southeast Asian countries too where in Philipine it was called 'Sepa Sepa', in Myanmar, 'Ching Loong', in Indonesia, 'Rago' and in Laos, 'Kator'. When it is born, it looked like Japanese 'Kemari', and some became a circle and a pole was kicked, and the number of times was being competed in. It looks very similar to the Japanese traditional game, 'Kemari' where the players form a loose circle and the number of times the ball is kicked before it touches the ground is counted.

In 1965 the game was unified into the present volleyball style with the addition of a net and the adoption of international rules. The International Sepaktakraw Federation (ISTAF) is responsible of all the Sepak Takraw organizations. Modern Sepak Takraw, or Takraw for short (also known as Kick Volleyball), began in Malaysia and is now became their national sport. It combines elements of Soccer, Footbag, Volleyball, Baseball, Badminton, Gymnastics and the ancient sport of Sepak Raga. Balls woven of rattan stems have primarily been replaced by woven synthetic balls, which are much safer and more durable. A Sepak Takraw player needs to be extremely good when dealing with the ball. Under the current training method, a long period of training is needed to improve the skills. It is mainly because of the undeveloped training equipment which there is no automation tool is used during the training period. Until now, no ball feeder machine has been developed for Sepak Takraw. So, the players might have problem when it comes to dealing with accuracy training.

1.3 Problem Statement

The unavailable automated equipment in takraw training is the main problem that occurs. When it comes to accuracy training, players need a help from an expert coach or an assistant to work on the training. Currently, no individuals or company had developed the takraw ball feeder that specializes on accuracy training purposes. Like the other ball feeder available in the market, this takraw ball feeder will share the same concept, that is, to deliver the ball to the user within the specified accuracy. Unlike the tennis ball feeder [2], takraw ball has many holes which mean that a punching concept will be use to throw the ball. Previously, there is no ball feeder development for ball that contains holes like takraw ball. For this takraw ball feeder, the user can apply two specific type of training available; service and throwing. So, the invention of the takraw ball feeder will greatly improve the current training method and coaching.

1.4 Project Background

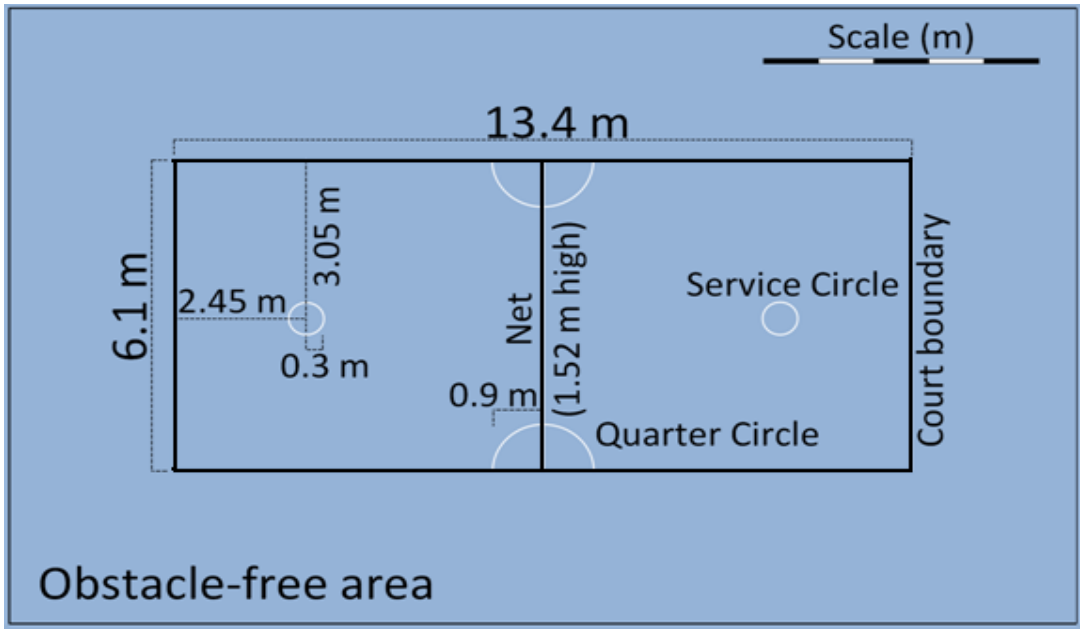

Figure 1.1 Dimensions of a takraw court

Figure 1.1 shows the dimensions of Sepak Takraw court. The Sepak Takraw court and net are of the same height and dimensions as in badminton. Area of length 13.4m and 6.1m in width free from all obstacles up to the height of 8 m measured from the floor surface.

At the corner of each at the center line, the quarter circle shall be drawn from the sideline to the center line with a radius of 0.9 m measured and drawn outwards from the edge of the 0.9 m radius. The net shall be made of fine ordinary cord or nylon with 6 mm to 8 mm mesh.

The net shall be 0.7 m in width and not shorter than 6.10 m in length and taped at 0.05 m from tape double at the top and sideline, called boundary tape. The net shall be edged with 0.05 m tape double at the top and the bottom of the net supported by a fine ordinary cord or nylon cord that runs through the tape and strain over and flush with the top of the posts.

The top of the net shall be 1.52 m (1.42 m for women) in height from the center and 1.55 m (1.45 m for women's) at the posts. From Figure 1.1, the distance from the service circle to the opposition service circle is 8.5m, and the distance from the quarter circle to the service circle is 5.23m. This is the distance for service and throwing purposes.

Using gravity punching concept is suitable to achieve that distance. The punching unit will contain a power window motor and a puncher connects by a shaft. Power window motor is being used because it has high torque transmission for lifting the puncher.

1.5 Objectives

1.5.1. To design and prototype a takraw ball feeder for sepak takraw training purpose.

1.5.2. Analyzing and testing the accuracy level of the takraw ball feeder prototype.

1.6 Scopes of project

1.6.1. Design via Solidworks, a takraw ball feeder that uses a gravity punching concept.

1.6.2. Design via Solidworks, the ball motion from the container to the punching unit by using appropriate concept (e.g. gravity).

1.6.3. Design the controlling unit for purchasing the period of launch.

1.6.4. Make a Solidworks design to test the strength of the ball feeder structure.

1.6.5. Fabricate the takraw ball feeder using appropriate material such as sheet metal, aluminum and motor that act as an actuator.

1.6.6. Testing and analyzing the takraw ball feeder and record the data.

1.6.7. Compare the result from experiment with the simulation data.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will briefly explain about the previous design and concept of ball feeder machine in variety field of sports, along with the information of the devices used throughout the process.

This valuable information is very important to decide the best application for development of the new takraw ball feeder. It is known that no takraw ball feeder machine has ever been developed. Therefore, the previous inventions of ball feeder in any sports are being set as a reference to get the best concept for prototyping a takraw ball feeder.

The previous inventions are also important to decide the devices and mechanism that need to be used in this machine along with its functions to minimize any weakness in prototyping the takraw ball feeder. It is also important to determine the design concept that will be applied during designing the ball feeder.

2.2 Basic Concept of a Ball Feeder

The main concept of a ball feeder is to deliver the ball to the user automatically within the specified speed and accuracy. It helps the user to improve the training method and to fulfill their training period effectively. Apart from that, a ball feeder should greatly increase the training efficiency. A ball feeder should contain two separate parts; the ball container and the launcher. It also must be lightweight, movable and easy to operate. To achieve the needed accuracy, the outlet nozzle must be adjustable which means the ball can be thrown in any direction horizontally and vertically. But all the concepts of ball feeder are depending on the type of application, which is different in each sport.

There were many concepts of ball feeder available in the market according to each sport. Although the concept is the same, different kind of sport used different approach of throwing or launching the ball. Different approach means the devices used is also different, based on what the objective of the invention. For example, tennis [1] ball feeder and baseball [3] ball pitching machine used different launching approach. Basically, a tennis ball feeder can launch the ball in any direction and can simulate the stroke or curling the ball so that the user can practice like playing with a real human. Elsewhere, baseball ball pitching machine doesn't need to curl the ball because in the real game, the ball pitcher throws the ball straight to the batter. This means, both machine have different trajectory of ball. Subtopics 2.4.1 until 2.4.3 will briefly explain the available concept of ball feeder in various sports.

2.3 Automation Components

Developing a ball feeder involve the use of several automation components to realistically throw the ball away from the machine and are crucial to achieve the needed accuracy. The components come from two different types which is mechanical components and electrical devices.

2.3.1 Mechanical components

Mechanical Components covers a wide range of items and devices designed to handle, induce or drive mechanical systems. In almost all cases, mechanical components were manufactured to be part of a greater system, and do not have the ability to function on their own.

Therefore, mechanical components are always connected with electrical components to make the whole system function. The used of mechanical components is different based on the type of application. Previous invention of ball feeder machines contains several simple mechanical components such as shaft, contact wheel, carriage, frame and adjustable lifting arm.

Figure 2.1 shows an example of mechanical components involved in a ball pitching machines for baseball application. The machine uses a tripod leg that is connected to the frame. Tripod leg is suitable for baseball and softball application because it is stable and light in weight. It also can reduce the cost because of its simple yet effective design.

The first contact wheel function to propel the ball when the ball is introduce at the entry point, allowing the ball to move upward along the ball track to the second contact wheel. The contact wheel is rotated by an electric motor and is connected by a shaft.

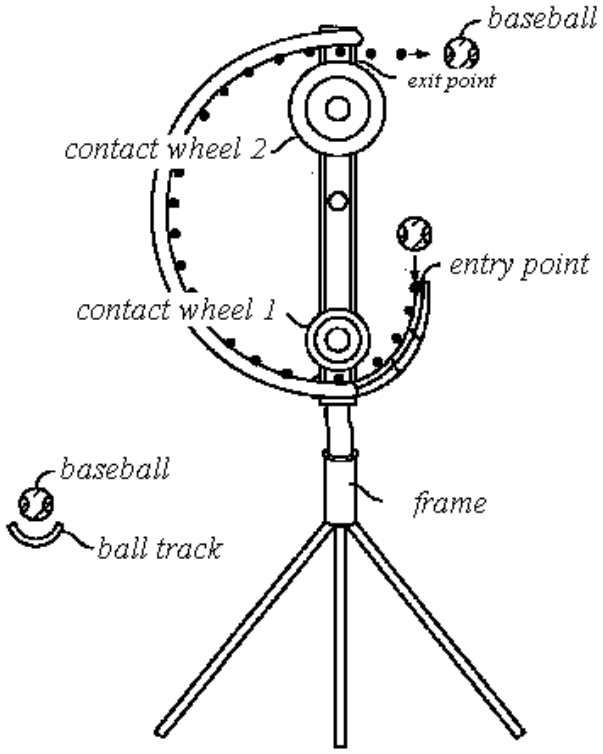

Figure 2.1 Mechanical components in a baseball ball pitching machine [3]

2.3.2 Electrical devices

Mechanical components can't perform without the use of electrical components. An electrical device is a combination of many electrical components that where attached to each other to perform a certain function. An electronic component is a basic electronic element usually packaged in a discrete form with two or more connecting leads or metallic pads.

Components are intended to be connected together, usually by soldering to a printed circuit board, to create an electronic circuit with a particular function (for example an amplifier, radio receiver or oscillator).